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ABSTRACT

To use devices aimed at combating our major educational problems with the disadvantaged, we need criteria based upon learning theory which will reveal for each of the types of media their competetively established efficiency. In the meantime, in the areas of greatest educational need, we need technology that involves many senses; permits the learner to get into the curriculum; makes possible the braided trilogy of sound, text, and pictures; and brings freedom to the act of learning for each learner. (SP)

TECHNOLOGY AND THE EDUCATION OF THE DISADVANTAGED

by John Henry Martin*

Education for the disadvantaged, the children of the poor of our inner cities or Appalachia, the American Indian children, the children of the Spanish speaking, has in the short space of the past five years moved from the remediation or correction of social and physical pathology to a recognition that education itself must be reformed. We agreed early that among the children of the poor, the high incidence rates of dental caries, eyesight problems, dietary deficiencies, physical defects, psychological disorders, as well as poor neighborhood conditions and inadequate family patterns of child rearing needed sharp additions of supplementary services. Each of these ills may be damaging to a child's capacity to learn; all require attention.

But we are now recognizing the unhappy truth that the remediation or correction of these pathologies is not enough to produce children who will then learn. It was comforting to those of us in education to believe that our educational failures were in effect environmentally produced; that our curricula and techniques worked well if a child was healthy and came from a

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stable home. If any mixture of deficits afflicted a child, then the removal of the difficulties were all that was needed to produce an eager and successful learner.

Head Start was conceived in these terms as a "total delivery system, broader than just education" to mobilize corrective medical, dental, social and educational components so that normal and regular schooling would be successful. We soon found that the spurts of measurable growth achieved during the Head Start period were not sustained or were erased subsequently in the kindergartens and the first grades. A clue to the reason can be determined from an examination of the educational programs of Head Start. For Head Start spawned a wide variety of classroom patterns ranging from baby-sitting, day care centers to replicas of middle class child development nursery schools. Basically, whether poorly or well operated, they shared in common a non-academic orientation with major emphasis for the most part being devoted to social and physical maturation exercises rather vague in practice and equally vague in the language used to describe them. The need for a rigorous reexamination of the central educational objectives with behavior goals and an equally disciplined description of the curricular options

to fulfill these is now becoming clear. In other words, Head Start did accomplish much in the remediation of children's deficiencies in every area except that of education. But the central issue of the appropriateness of the educational program to the cognitive and language development of disadvantaged children was not met. Initially, the oversight in not designing an educational program specifically to meet the deficiencies of the disadvantaged youngster, was either not seen or was actually resisted as being unnecessary.

Coleman's study revealed that significant educational growth occurs where the social class mix in a school shows a clear numerical dominance of middle-class children over children with parents of low income. All other measurable educational reforms were of little or no consequence when measured against economic class. Neither class-size, nor dollars of expenditure nor remediation services, nor physical facilities, nor experience of teachers, made for significant differences in school achievement. Hidden in these findings is the startling interpretation that our schools can only teach children who come from homes which provide certain pre-requisites for learning. Looked at in these ways, the school curriculum and the teaching procedures seem to work when they work at all when the children of the

middle-class white or black come to school with attitudes and behavioral dispositions in harmony with the schools patterns. For example, from infancy, the middle class child is raised in a home where parental approval is heavily weighted toward language development. "See the light." "Show Daddy." "Say, Da Da." "Say, Ma Ma." "Tell Grandpa." "Show Grandma how you can say airplane." Brightness in speech is the sure bestower of family awards. This frequently competitive exercise with siblings however physically damaging it may become, produces children well trained in seeking adult approval for verbal performance. Children spoken to, read to, and rewarded or denied approval, based upon parental estimates of language dexterity, enter school classrooms well prepared for a curriculum and teaching which maintains the same reward system and which presumes a language maturation able to cope with its materials and print media. But for large masses of our children, this family environment is only partially or not present, and our schools have as yet not designed a new pedagogy to fit these circumstances.

We are learning the tremendous importance of the first five years of life to the total intellectual growth of a human. Freud, 50 years ago, called attention to the decisiveness of these first five years of life

to the emotional and personality development of every adult. We have recently awakened to the cumulative evidence indicating an almost equally controlling role for early childhood to much subsequent intellectual and cognitive power. Out of concern for family, or ignorance of early childhood's importance, education has until recently ignored these vital years.

We are also learning the consequences of the biological fact that by age four and a half, 50% of the total growth of the human brain is accomplished; that two-thirds of its growth is completed at age six. Bloom, at the University of Chicago, in an examination of over hundreds of studies of human growth and development, has concluded that the time for most effective intervention, or when the environment can have maximum consequences, is during the period when the organ or trait has its greatest rate of growth. Unhappily, the research shows that environmental neglect during this same early childhood period actually leads to a suppression of the growth of intelligence. Our antique assumptions about the genetic immutability of intelligence must now give way. We know that for millions of our children we have a system extraordinarily effective in reducing I.Q.'s by 20-30 points between infancy and adolescence. We can sometimes with great difficulty and expense bring it

back. The evidence is now conclusive that with improved child rearing practices and the introduction of technology and other changes in education, we can enhance it.

IMPORTANCE OF LANGUAGE DEVELOPMENT

Some indications of what is needed came six years ago from the long-suppressed reports of Vygotsky in Russia. Vygotsky emphasized the central importance of language development in the growth of mental competence. Verbal symbols become the language of the brain. Enhance these at the appropriate growth periods in early childhood and intellectual fertility will occur. Similarly, studies now show that if this act is interfered with, if speech is repressed, cognitive growth is retarded. The phenomenon is world-wide and is most closely associated with poverty.

Israel has encountered language retardation with the children of oriental Jews. These households may be filled with the noise and the sounds of living, but not with the language of communication with infants. Children are told, not answered. In the inner cities of America, getting out of the way, shutting up, and avoiding physical punishment are early requirements for survival. It is a noisy world full of radios, television, loud voices, but with extremely limited

language-building inter-relationships. Sub-verbal sounds, grunts, groans, commands, shouts, single-word sentences, are abusive not just to the sight of the child, not just to the personality of the child, but to that child's linguistic and hence cognitive and intellectual growth. This is what we mean when we speak of the educationally disadvantaged, as distinct from the physical and social pathologies in which they are immersed and until recently remained hidden.

Montessori, Italy's first woman physician, 60 years ago, between 1900 and 1910, developed Casa Bambini, children's houses in Rome, for the slum children of that city. The techniques she developed took institutionalized children, mental retardates and psychotically disordered, and made them capable of passing examinations in Italy's primary schools. Her principles, now being rediscovered and expanded, placed great emphasis upon re-evoking from children a sensory sensitivity to their surroundings. She found in the slums of Rome what Vygotsky found in Russia, Smilansky found in Israel, and Hunt and Deutsch in America: the children from non-verbal homes are dulled and depressed. She blindfolded them so that they could see through the feel of their fingers; she put the Roman alphabet on sandpaper so that they could feel the shape of sounds. She said

that the act of learning is at its best when a child works his way through highly organized material, and that the thing to be learned should be structured so that the child can make his own discoveries. She developed, with a fertile brain, a host of these devices, some of which have become culturally obsolete, such as button hook frames. Others continue in their simplicity to work effectively today.

Her program in the United States died before World War I, when Kilpatrick, high priest of Dewey's philosophy of education, pronounced her doctrine heretical.

In America we have suffered for 30 years with a distortion of a fractional truth called child development. Gesell, at Yale University, studying upper-middle class children from a suburban collegiate community, found normal behavior growing in ladder-rung precision. He and his followers announced what four-year-olds and five-year-olds and six-year-olds in theory could do. It followed that it was fruitless to teach earlier, since the stage of development of the youngster would not permit success. When he was ready he would learn. Readiness became an educational cliche that for all the gentleness of its intent served to prevent effective development of language growth and reading in our nursery and early childhood programs. Readiness was locked to

the calendar and the clock, and we retarded all our children because at age five they weren't 'ready.' It would be grossly unfair to attribute all of these consequences to the Gesell School. Unfortunately, the widely supported application of these views was most damaging to the disadvantaged child.

With this brief background of some of the developments and some of the historical influences affecting the disadvantaged child today, we raise the question: 'What can be done?' May I point out that there is growing recognition that the billions we have spent in the past several years applying more of the time-honored solutions have resulted in little of consequence. We reduced class sizes, we added remedial, psychological and social services, we filled the cupboards of our schools with paraphernalia and gadgets patched on to a system that remained unchanged. In short, we have spent much and gotten little.

At this point we can either retreat to a negative view that black children, Indian children, children of the rural poor and children of Spanish speaking parents are doomed genetically to being inferior learners for whom no educational program will work or we can analyze what technology can do to change the content and style of education to match the needs

of these children.

We believe that technology will make the difference. To do this:

1. A child to learn as an individual must be freed from the lock-step process within a group. Much learning is a private thing.

2. Technology ought to free the teacher from a concept of pedagogy which manipulates children.

3. That which is to be learned early through educational technology should be the languages of man's intellectual life: first and foremost, talking and reading and writing. Secondly, the languages of mathemathics and music should be included.

I am deliberately leaving to the side the role of the other arts as forms of expression and communication.

4. Educational technology must make it possible for the learner to correct himself. Rapid feedback of the consequences of his actions is important.

5. Instruments for learning, as I am defining them, produce in the learner a sense of competency. Learning with technology is largely tutorial in its appearance. However, the learner in a very private sense is doing it himself. We all can recall the sense of exuberance with which a child says, 'I do it myself.' and similarly all mothers know the muscular determination of the spoon-fed infant to grasp a spoon with strange vigor in the early months of life. The three-year-old's

determination to put on his own clothing is a symptom of an internal compulsion that education has ignored. A child in a learning environment responsive to him can and does achieve the same self-learning.

6. Implicit in the above is a shift from efforts to motivate learning based upon peer and sibling rivalry and social competition exploited by the school to the learning energized by the self-growth and self-enhancement made possible by individualizing learning through technology. The disadvantaged child does not respond very well to the extrinsic reward and denial system of the schools typically withdrawing in either fright or hostility from these appeals. The act of learning produces an inner sense of well being. The power of this experience to generate additional learning is the central dynamic change technology can bring to the education of the disadvantaged.

Montessori, as every great teacher, has described the jumping up and down, the handclapping, the total exuberance that fills children when self-learning has occurred. Leonard, in the United States, has recently said that our goal in education should be the restoration of ecstasy to the human experience. Leonard realizes that this would put education in competition with other things. Technologically engendered learning bridges the artificial dichotomy between entertainment and education - the first sought the second imposed.

We have seen thus far that the need for change in education is great; that infancy is a new frontier of importance to the quality of society; that large numbers are not now being reared or subsequently given a form of education that produces a literate and inquiring child or adult; that standard remedies are not working; and that a powerful educational technology can make a fundamental contribution to the relief of these problems.

If these are the ambitious, as well as vitally-needed goals, we now must ask how can educational technology reach them. It can do that if it isn't a gadget representing a fragment of the learning act. And it is a fragmented tool if it engages his senses only partially, if it excludes one or more of his sensory capabilities, and if it leaves him in a passive non-participating role. Consequently, technology to be effective in the basics of education must be multi-sensory in its capabilities.

A moment on the importance of multi-sensory media. Each of us attends to each experience with a unique mobilization of his senses. Some of us find it easier to see through our eyes while others see best by listening. Touch and grasp are of dominant importance to others. And labial learning is a common

public display of our times.

At present we cannot predict differences in sensory styles from one child to the next. Consequently, curricular material for 'normal' children has never been seen as needing to be prepared for those who are dominantly one sense minded as distinct from another. And if we could, there is reason to believe we shouldn't. This much we know: that whatever the dominance of one sense over the other, they are mutually supportive and in learning all are used. If the structured environment called curriculum or technology fails to make possible the conscious or unconscious exploitation of these separate pathways to the brain in the random fashion required by the range of human differences, then the curriculum and technology emasculate learning. We can and do learn through the eye alone. We can and do learn through our ears. But we learn better, and in some cases we can only learn, if the learning environment, the technology, permits each of us to probe it with a sensory mix unique to himself.

THE LEARNER'S ACTIVE ROLE

A second major requirement of technology is that it be seen as a system whose behavior can be manipulated by the learner. The learner must do things.

He must be involved. Passive sitting to 'look and listen' exercises bottoms more than brains. If this were not so our television-saturated society would not be confronted with immense problems in education. The learning setting, the specialized environment called technology and its curriculum, must respond to the initiatives of the learner. The learner's capacity to intrude is a high requirement of all good education. In technology it makes the difference between learning systems and gadgetry, however complex.

Learning is not a spectator sport. An aspect of this participatory learning is the requirement that the learner's dominant role permit his random exploration of the material. He must be free to go forward, to reverse himself, to repeat in his own style within the broad frame of the program design. Self-pacing is certainly a great virtue of teaching machines. But when speaking of self-pacing one must not assume that speed is the dominant difference among learners. This would ignore differences in human learning styles involving the senses as well as every child's needs for random exploration. This oversight stems in large part from a concept of programming largely linear in format. If material to be learned is structured in ladder rungs in step-by-step fashion, then speed of

learning becomes the dominant observable variable.

From this concept of ten years ago we have come a long way. Programming capability has grown as technological sophistication has increased. Unfortunately, it is necessary to be critical of the continued narrowness of the conceptual design of both the instructional software and of the technological delivery system as they have circumscribed each other. If the program is linear, if the responses of the learner are limited to simple yes or no or multiple choice conventions, then the instrument may be a push-button machine and a weak version of what educational technology can and should be.

Excessive linearity, ladder-rung precision, however compensated for by periodic branchings, produces a rigidity foreign to the optimal behavior of a learner. The intake process from infancy through maturity filters the kaleidoscope of the environment. During the learning act the seeming irrationality of the learner's probes - who from moment to moment closes his eyes in order to hear, tunes out the sound of the teacher or the television announcer while seemingly continuing to attend to that learning situation - is a complex which technology and its programs must invite and not prevent.

When he is given control over these technologically structured pieces of the environment, he will pick and choose, more forward and backwards, call for repetitions in a random, personalized fashion. It requires an arrogance equal to that of the pagan gods to assume that a curriculum programmed in conventional style will do more than constrict most learners. As one of our associates has said, every human being has a learning print as unique as his finger print.

But if I left you with this picture of the functioning behavioral requirements of technology, I would seemingly have described anarchy. Structure enters this picture through an examination of the material, the subject, the skills, the concepts to be learned. Bruner, at Harvard, has made a major contribution to our thinking by pointing out that there is an internal integrity to human knowledge in many of its areas. Thus it is that to the teaching of reading we bring the findings of students of linguistics and language, to determine its internal structure, its phonetic base, and hence the concepts and skills needed to derive meaning from silent speech in print.

A second area that brings reason to the software instruction material programmed into the technology is our growing realization that words in

print called textbooks are severely limited pedagogical instruments with and without teachers. An example is the way we have used art and graphics. Despite the ancient Chinese injunction about the value of a picture, art and graphics have been used as after-the-fact, patched-on affairs. We saw, thanks to the discipline imposed by the comprehensive instructional technology of the Talking Typewriter, and we are now seeing again in the Talking Page, that there is much in learning that can be graphically represented and that these graphics can and should carry a large portion of the content in harmony with and integral to the rest of the text. There is no reader who has not been irritated with a reference to an illustration several pages removed. An irritated adult is a child not taught.

The sound motion picture, 40 years old in entertainment and neglected educationally, showed us that the marriage of the human voice and other sounds with pictures and motion had a new efficacy in learning, despite its limitations due to its inability to permit the learner to get into the act. Now through a trilogy of graphics, text and sound, with as much pedagogical attention to each and then to their inter-relationship, a whole new organization of curricular materials is made possible by a new educational technology.

Last, the responsiveness of the technology, this interaction with the material, the consistency of the environment's responses during the act of learning, alll become vital to the learning efficiency.

A SENSE OF DISCOVERY

We are re-discovering the importance of exploration leading to inductive reasoning called discovery. Hunt has called this the match, the spark that closes the gap between the known and the unknown. This is the discovery process in learning. Our old reliance on the deductive process, in which rules are given and applications mandated, is still too much with us and technology and its software should not prolong its excessive use.

How now do we examine the long and growing list of devices aimed at contributing to the relief of our major educational ills? We could catalogue overhead and film-strip projectors, turn-tables and tape recorders, 16mm and Super 8 mm projectors, television in broadcast and closed circuit, old-fashioned radio, light pencils and touch sensitive surfaces, new fashioned audio-visual instruments, dial access tapes and cassettes, the computer based Talking Typewriter, computer asssisted instruction and the Talking Page. We now need criteria based upon learning theory which will reveal for each

of these their competitively established efficiency. Each of these will teach some things to some children. Some of them will teach uniquely well to some learners, under certain circumstances. Because they differ in total cost we must not assume they do not differ in effectiveness for particular kinds of learning. We have lived with a kind of hidden hypothesis that one of these would be better than all others for all purposes. This is not so. Each can induce learning but for some children and some situations, each of these devices has its own unique contributions. For example, a sound motion picture or television presentation of a dramatized situation is an extraordinarily effective means of having concepts understood and values learned by large groups. The same media has severe limitations in effectiveness and costs if used to teach technical skills and certain dexterities. Until we begin controlled research to delimit the behavioral parameters of kinds of technology most useful for certain learnings and for certain learners, we will continue our over generalized use of particular technologies. Systems analysis devoted to instrumentation in these terms holds great promise. We will then neither accept nor reject closed circuit television because it will or will not teach all subjects to all learners. In the meantime, in the areas of greatest educational need, where present methods continue to do poorly, we need

technology that can respond affirmatively to these criteria:

1. Does it involve many senses?

2. Does it permit the learner to get into the curriculum?

3. Does it make possible the braided trilogy of sound, text, and pictures?

4. Does it bring freedom to the act of learning in the unique random style of each and every learner?

If it does, we have a learning system that can address itself to the present problems of the educationally disadvantaged. Partial instrumentation will fragment the effectiveness of the handicapped learner. Just as the school cannot parasitically exploit motivations and behaviors induced by middle-class child rearing modes to reach the children of the poor, technology addressed to these conditions must have an autonomy and multi-dexterity of behaviors that will induce learning in these children as they are. Such multi-dextrous instruments will empower a new generation of learners despite a social milieu which the schools cannot change and society must.